

IMPROVEMENT OF CHARGE AND OVERCHARGE CHARACTERISTICS
OF SILVER CADMIUM CELLS

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Several satellites launched by NASA/Goddard have orbital periods up to 100 hours. Prolonged periods in sunlight require the batteries to be subjected to continuous charge and overcharge. This type of operation of silver cadmium cells results in cell voltage unbalance and subsequent gas evolution. Optimum cell design, improved methods of charge control and cell selection techniques have been developed to alleviate this problem. In addition, recombination electrodes and improved separator materials have aided in minimizing the problems associated with cell unbalance.

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of the average can result in battery failure. To overcome the dryness problem at the positive electrode, use of non-woven nylon rather than woven nylon on the positive has improved cell performance. Improved wicking has shown that cells in series can be trickle-charged at constant potential with less than $\pm 1\%$ variation in cell to cell charge voltage. Gauges have been developed to accurately measure the expansion of cell components. The tolerance variation in the swelling of separator materials, particularly cellophane, requires modification in cell design as a function of lot to lot variations in separators. Also new separator materials, modifications of methyl cellulose, have been developed which have uniform swelling characteristics and are not as readily attacked by silver oxide, therefore carbonate formation is reduced.

The use of recombination electrodes in silver cadmium cells has shown that operation of a sealed cell at less than two atmospheres absolute of internal pressure is possible. It has also been noted that operation of cells with recombination electrodes tends to restrict voltage excursions of cells to a minimum, i.e., within $\pm 2\%$ of the average charge voltage.

An improved method of charge control has been developed and is presently being incorporated into satellite design. During constant potential charging, as the battery becomes charged, the charge current decays to low levels. With properly formed cells and optimum cell design, cell unbalance will not occur as long as the current is greater than $C/100$.* The new charge control method lowers the battery charge voltage when this low current level is approached. For instance, a five ampere hour battery that is modified constant potential charged at 1.50 volts per cell until the charge current decays to 50 milliamperes will then be switched to a lower charge voltage which is at or near open circuit voltage of the battery. At the lower charge voltage, cell unbalance ceases to be a problem.

As aforementioned, when a silver cadmium battery is trickle-charged for extended periods of time and then discharged, the voltage can initially drop to about 0.98 volt per cell and then will recover to a higher level (1.06 volts per cell). This phenomenon is a function of temperature occurring at 25°C and 50°C but not at 0°C.

At the lower temperature, the AgO is more stable and therefore the cells will exhibit the higher plateau voltage. The battery is only 60% charged at low temperature; therefore,

*c = rated battery capacity

the absence of occluded oxygen and/or the presence of free silver could account for a lower resistivity of the positive plates. Tests of batteries with the variable voltage charge control mentioned above indicate this mode of charging also will alleviate this voltage depression at beginning of discharge.

Reference

1. Technical Note D-1543, Goddard Space Flight Center, "Use of a Sealed Silver Cadmium Battery on Explorer XII," by T.J. Hennigan and A.O. Apelt, dated Jan. 1963.